DOCUMENT RESUME

ED 038 318 SE 008 289

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TITLE Individualizing Instruction, Set A, Using Research: A Key to Elementary School Mathematics.
INSTITUTION Pennsylvania State Univ., University Park. Center for Cooperative Research with Schools.
PUB DATE [70]
NOTE 8p.

EDRS PRICE EDRS Price MF-$0.25 HC-$0.50
DESCRIPTORS *Elementary School Mathematics, *Individualized Instruction, *Instruction, *Mathematics, *Research

ABSTRACT

Reported are the suggestions indicated by research studies to six questions concerning individualizing classroom instruction. (1) What factors should be considered? Answer: No one way is best, but consideration should be given to factors of achievement, interest, content, method, ability, personality, and socioeconomic status. (2) Are sex differences important? Answer: No conclusion. (3) Does diagnosis help? Answer: A student should get specific remedial help for specific errors, in a program of testing, reteaching, and retesting. (4) What types of grouping are effective? Answer: No conclusion; the teacher seems to be most important. (5) What is the effect of acceleration? Answer: Acceleration is most beneficial when the children are very carefully chosen. (6) How may instruction be effectively individualized? Answer: No conclusion. (RS)

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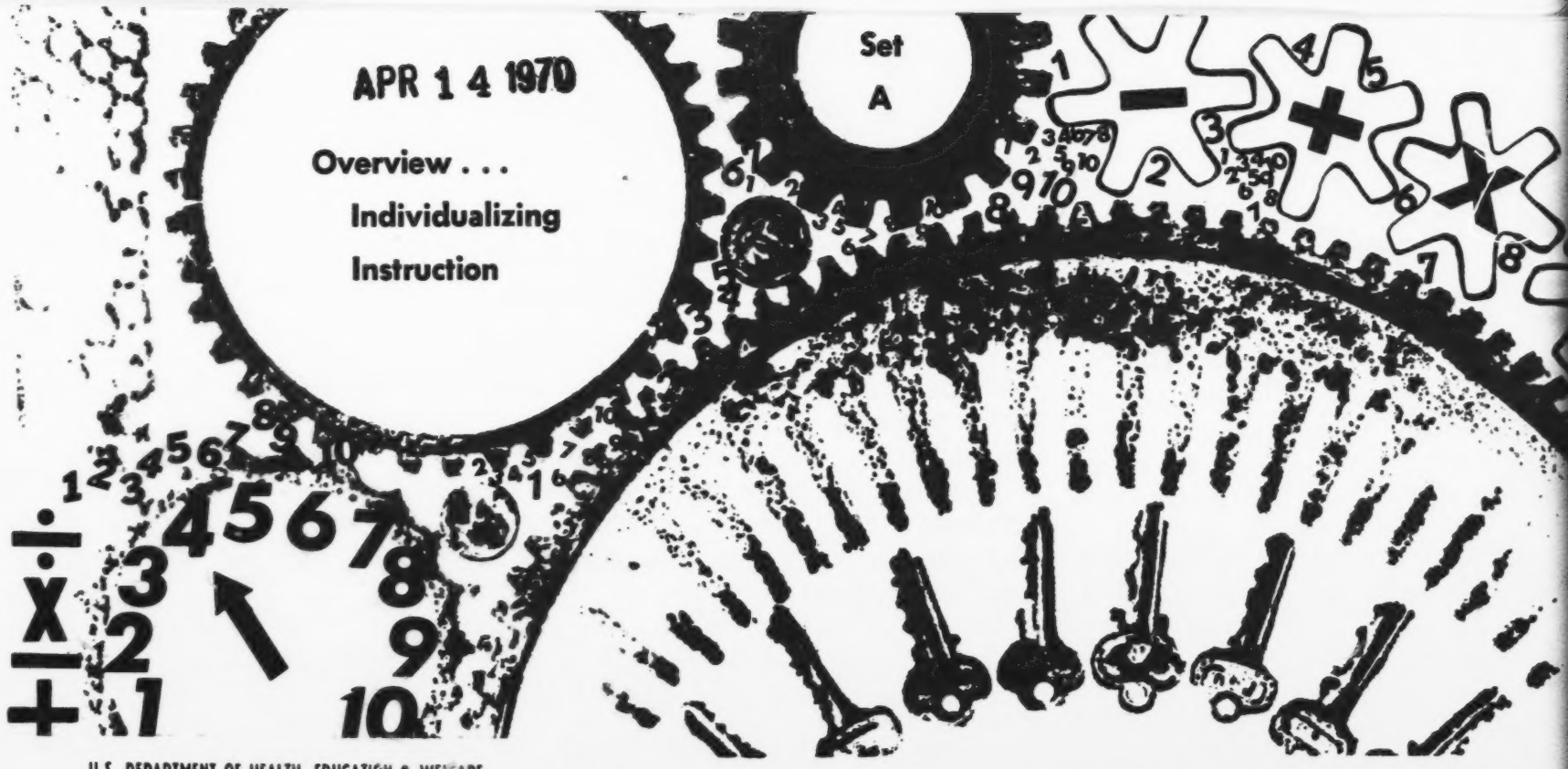

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INDIVIDUALIZING INSTRUCTION

What factors are important to consider when individualizing instruction?

It seems apparent that there is no one best way to individualize instruction. You must identify various factors related to achievement and interest in mathematics, and then decide on appropriate variations in content, materials, method, and time.

Mathematical ability has been found to be a combination of intellectual, numerical, and spatial factors, with a verbal factor which is highly related to intelligence. It has been suggested that certain personality factors or emotional difficulties may be more important than intelligence as a factor contributing to lack of success in mathematics. Socioeconomic status also influences achievement, with achievement level increasing as socioeconomic level of the parent increases.

Some research has indicated that some students can be identified who will achieve better when taught inductively, while others learn better when taught deductively. Thus using a method appropriate to the learner is one way of individualizing instruction.

Should boys and girls have a different mathematics program?

While some researchers have reported that boys tended to score higher in mathematical reasoning and girls were better on fundamentals, most concluded that what little difference exists is not sufficient to influence curriculum decisions.

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How does diagnosis aid in individualizing instruction?

You should ascertain the specific errors which a pupil is making, determine specifically how he works, and give specific remedial help.

Diagnostic tests for skills are available, and some tests which focus on understanding of mathematical ideas are available. You may find that observing and questioning children as they work is one of the best ways of ascertaining how they think as they do mathematics. These techniques provide you with information on what and how to teach him.

A testing-reteaching-retesting strategy will help to decrease the errors pupils make.

What types of grouping are effective?

Grouping on the basis of ability has been found in some studies to be especially effective for those at upper ability levels. The findings of research on grouping on the basis of achievement have been much more variable. Apparently the most important factor in grouping is the teacher: a good teacher will be successful regardless of the pattern of grouping used.

What is the effect of acceleration?

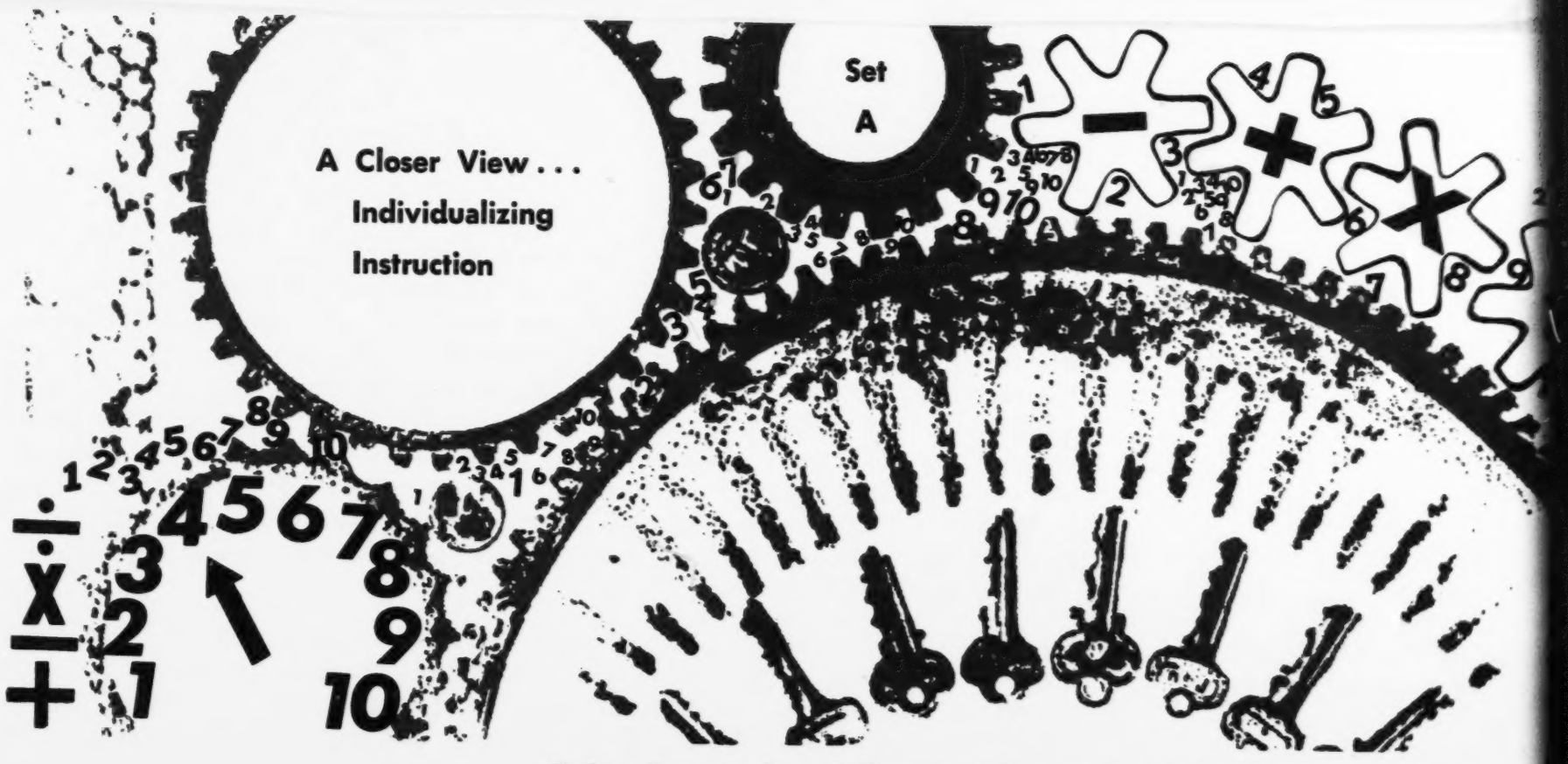
In general, acceleration has been reported to be effective for some children. Unfavorable academic, social, emotional and physical problems seem to be minimal when children are carefully selected and the program is carefully planned.

How may instruction be effectively individualized?

All in all, there is little substantial evidence to date indicating that programs of individualized mathematics instruction will lead to higher levels of pupil achievement when compared with non-individualized programs. Perhaps how each teacher teaches is the most significant factor, and obscures differences between the two types of programs.

The material included in this bulletin is a product of the "Interpretive Study of Research and Development in Elementary School Mathematics" (Grant No. OEG-0-9-480586-1352(010), sponsored by the Research Utilization Branch, Bureau of Research, U.S. Office of Education, and conducted at The Pennsylvania State University.

If you would like more information about the research whose findings are cited above, contact MARILYN N. SUYDAM, Project Director, at The Pennsylvania State University, University Park, Pennsylvania, 16802.



INDIVIDUALIZING INSTRUCTION

By individualizing instruction we mean attempts to organize mathematics programs and instruction in relation to the unique needs and abilities of individual children. This includes, but is not restricted to, plans in which individual pupils work more or less completely independently. It seems apparent that there is no one plan which is best. Provision for individualizing is conditioned in part by school organization, in part by the particular teacher and pupils. The teacher must identify various factors related to pupils' achievement and interest in mathematics, and then decide on appropriate variations in content, materials, method, and time.

What factors are important to consider when individualizing instruction?

Wrigley (1958) was among those who studied the structure of mathematical ability. He concluded that high intelligence is the most important single factor for success in mathematics. He isolated a mathematical group factor which linked the different branches of mathematics, as well as specific verbal, numerical, and spatial factors which affect achievement. When the influence of intelligence was eliminated, verbal ability had little connection with mathematical ability.

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The bulletin was prepared by MARILYN N. SUYDAM, The Pennsylvania State University, Project Director, and J. FRED WEAVER, The University of Wisconsin-Madison, Project Consultant. Art by Ed Saffell.

It should be noted that research is variable with respect to its quality; hence, the same degree of confidence cannot be placed in all findings. An attempt has been made to take this fact into consideration in preparing this bulletin.

It has been suggested that the most feasible way of coping with individual differences might be to alter instructional methods to fit the aptitude pattern of the learner. To ascertain whether students high in a given ability achieve better under one method of instruction than under another, King, Roberts, and Kropp (1969) tested 426 fifth and sixth graders after instruction with one of four sets of materials on elementary set concepts. There were significant interactions on inductive-deductive comparisons: it appeared that some students were identified who achieved better when taught inductively, while others achieved more when taught deductively.

Capps (1962) tentatively concluded from a comparison of "superior achievers" and "underachievers" that retardation in mathematics might be related to personal adjustment: perhaps emotional difficulties tend to foster difficulties, and vice versa. Other researchers have also suggested that personality factors may be more important than intelligence in promoting retardation.

Should boys and girls have a different mathematics program?

Jarvis (1964) and Powell, O'Connor, and Parsley (1964) concluded that in general boys scored higher in mathematical reasoning and girls were better in fundamentals, though some conflicting evidence has been presented. Still other studies report no significant achievement differences associated with sex, and most researchers conclude that what little difference exists is not sufficient to influence curriculum decisions.

What is the effect of socioeconomic level on achievement?

There is evidence from research that children from low socioeconomic groups have less mathematical background when they enter school than do children from middle socioeconomic groups. Passy (1964) reported significant differences among third graders, with achievement level increasing as socioeconomic level of the parent increased. Unkel (1966) found that socioeconomic status had a significant effect on achievement in mathematics at all intelligence levels in grades 1 through 9.

How does diagnosis aid in individualizing instruction?

The purpose of diagnosis is to identify strengths as well as weaknesses, and, in the case of weakness, to identify the cause and provide appropriate remediation. As part of the process, there have been many studies which ascertained the errors pupils make. For instance, Roberts (1968) suggested that teachers must carefully analyze the child's method and give <u>specific</u> remedial help.

Most diagnostic tests have been concerned with skill development, but recently the focus has shifted to concept development. Paper-and-pencil tests such as those by Flournoy (1968) and Ashlock and Welch (1966) are not essentially diagnostic, but have implications for those attempting to diagnose pupil understanding.

Bernstein (1959), in a review of the research on remedial teaching of mathematics, noted that every cited experiment used lesson plans based on individual diagnosis as a basic teaching approach. Gray (1966), in reporting on the development of an inventory on multiplication, called attention to the individual-interview

technique pioneered by Brownell: "facing a child with a problem, letting him find a solution, then challenging him to elicit his highest level of understanding."

The Buswell and John (1926) diagnostic study on the four operations, in which the technique of skillful questioning and observing of pupils as they work was employed, has long been of interest. They stress the need to analyze how the child works, which should lead to devising ways of teaching him better methods.

Harvey (1953) reported on diagnostic tests for each operation, and suggested the use of a testing-reteaching-retesting strategy to decrease errors.

How may instruction be effectively individualized?

[For "IPI," see Bulletin A-2.]

Bartel (1966) compared achievement among fourth graders under two treatments: (1) a program of individualized instruction which included content from the "new mathematics," and (2) a "traditional" program, which was not individualized and did not include "new mathematics" content. No significant difference was observed between the two treatments on standardized tests. On a special "Concepts Test," pupils in the individualized program scored significantly higher. Was this difference due to the individualization factor or to the content factor? The design of the investigation does not permit an answer.

Snyder (1967) found no significant differences in achievement between seventh and eighth graders who were allowed to select the mathematical topics they would study and those who could choose from a three-level assignment option. Both groups gained more on reasoning tests and less on skill tests than a third group receiving regular instruction.

McHugh (1959) reported on a two-year differentiated instruction program in grades 4, 5, and 6, in which extensive in-service help was provided to develop a program in which pupils would progress at their own rates, become self-directive and self-correcting, and give mutual help. Significant gains in problem solving were found in grades 5 and 6, and in computational skills in grade 5. The program produced gains "greater than normally expected for the IQ level" in all grades.

Lindgren (1968) reported no significant differences between team learning and learning through conventional teaching in grades 4 and 5, while Wolff (1969) found no significant differences in achievement among third-year pupils in individualized graded or non-graded classrooms.

All in all, there is little substantial evidence to date indicating that programs of individualized mathematics instruction will lead to higher levels of pupil achievement when compared with non-individualized programs.

What types of grouping are effective?

Intraclass grouping to facilitate individualization of reading instruction is a common practice in the elementary school. Evidence on the effectiveness of grouping for mathematics

instruction is conflicting. Part of the conflict is due to grouping on different bases: ability and achievement.

When grouping is based on ability, some studies have shown that homogeneous grouping is especially effective for those with high IQ's (e.g., Provus, 1960; Balow and Ruddell, 1963). Balow and Ruddell, however, found "decreased-range" grouping was more effective than either heterogeneous or homogeneous grouping for most pupils, while Savard (1960) found that such grouping tended to be effective for lower ability pupils and of less advantage for upper ability pupils. Balow and Curtin (1966) reported that grouping by ability did not significantly reduce the range of achievement.

Wallen and Vowles (1960) had each of four sixth-grade teachers use both ability and non-grouping methods for one year. No significant difference was found, though a significant interaction was found between teachers and the methods used. This was not tested in most other studies, and may be the most significant reason for differences in findings.

When grouping is based on achievement, Koontz (1961) found that fourth graders who were heterogeneously grouped achieved significantly higher scores than those homogeneously grouped. Dewar (1963) concluded that providing three intraclass groups benefited high- and low-achieving groups more than did total-class instruction.

Holmes and Harvey (1956) found that there were no significant differences in achievement, attitude, or social structure within the classroom whether pupils were grouped permanently or flexibly (with the topic introduced to all, followed by grouping for further work).

Davis and Tracy (1963) reported that pupils in grades 4, 5, and 6 in self-contained classes scored significantly higher on factors such as verbal and quantitative ability, self-concept, anxiety, and attitude, than did those grouped by both ability and achievement across classrooms at each grade level.

Bernstein (1959) concluded from his review of research that differentiated instruction was more effective than total class instruction, for the general teaching of mathematics as well as for remedial teaching.

What is the effect of acceleration?

In general, acceleration has been reported to be effective for some children. Klausmeier (1963) reported no unfavorable academic, social, emotional or physical correlates of acceleration in fifth graders who had been accelerated from second to fourth grade. Ivey (1965) found that fifth graders who were given an accelerated and enriched program in grade 4 gained significantly more than those receiving regular mathematics instruction.

Jacobs, Berry, and Leinwohl (1965) reported that seventh graders who were in an accelerated program for either three or four

years did significantly better on concepts tests than those who had been accelerated for only one year. There were no significant differences on problem solving tests.

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